Inclusive muon yield from charm and bottom quark production at forward rapidity in p+p and p+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in the PHENIX Detector

XXVI international conference on ultrarelativistic heavy-ion collisions

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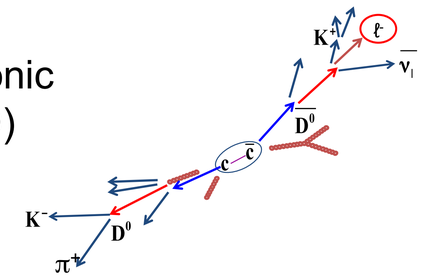
Abstract

PHENIX has studied the production of muons from the semi-leptonic decay of heavy-favor mesons in the forward rapidity region 1.2<|η|<2.2. e measurement of heavy quark production in *p*+*p* collisions is important as a baseline for studying hot and cold matter effects in heavy-ion collisions, and is a test of pQCD theory. In *p*+Au collisions, we can study cold-nuclear-matter (CNM) effects on heavy favor production. Measurement of charm and bottom yields will help to understand favor dependence of CNM effects. In 2015, a high-statistics dataset of *p*+*p* and *p*+Au collisions was collected with the Forward Silicon Vertex (FVTX) detector in PHENIX at RHIC. The complete PHENIX silicon vertex tracking system (VTX+FVTX) allows us to measure a precise primary vertex as well as the radial distance of muon tracks to the collision vertex. The distributions of radial distances for tracks from short-lived heavy-favor mesons (D and B) and long-lived light-favor mesons ($\pi^{\pm}$ and $K^{\pm}$) are sufficiently different to enhance the signal-to-background ratio, and allow the separation between charm and bottom. is poster reports the current status of heavy-favor muon analysis in *p*+*p* and *p*+Au collisions at 200 GeV with the PHENIX FVTX.

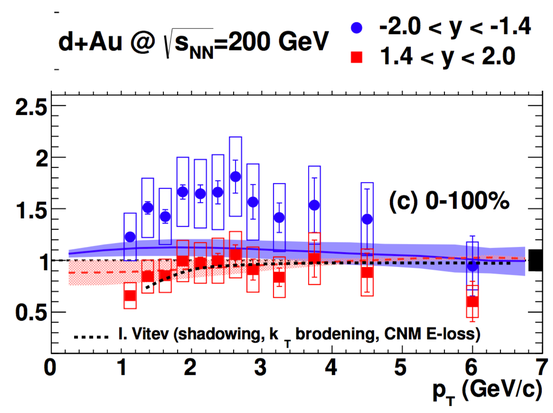
Motivation

Measuring muons from semi-leptonic decays of open heavy-flavor (B, D) helps us to study early stage of a heavy ion collision

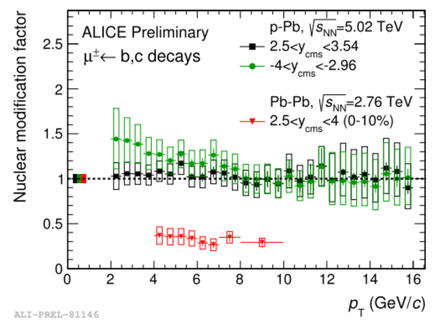


- *p*+*p* collision
  - a good test of pQCD
  - a baseline of *p*+A and A+A collisions
- *p*+A collision
  - probe cold nuclear matter effects
  - shadowing, initial-state energy loss, and k_T broadening, modification of parton distribution function

Previous results : PHENIX $R_{dAu}(c,b\rightarrow\mu^-)$ at $\sqrt{s_{NN}}$ = 200 GeV
ALICE $R_{pPb}(c,b\rightarrow\mu^{\pm})$ at $\sqrt{s_{NN}}$ = 2.76 TeV

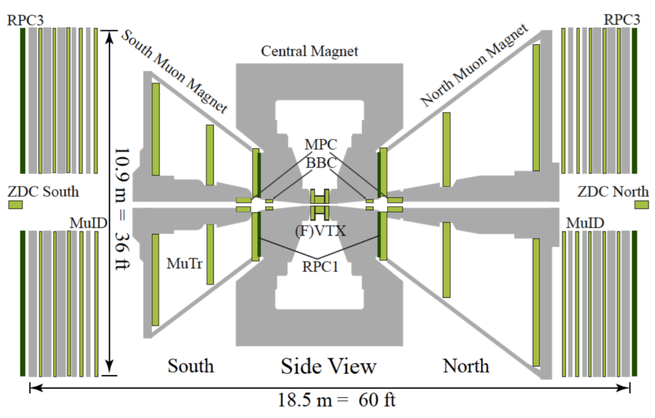


PHENIX $R_{dAu}(c,b\rightarrow\mu^-)$
PhysRevLett.112.252301



ALICE $R_{pPb}(c,b\rightarrow\mu^{\pm})$
(Nuclear Physics A 931 (2014) 546–551)

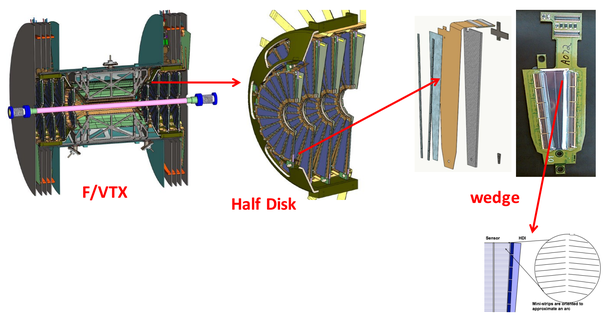
PHENIX Muon Spectrometer



- Muon Tracker
  - 3 cathode strip chamber for momentum measurement
- Muon Identifier
  - 5 layers each containing a plane of absorber and two planes of Iarocci tubes to identify muons

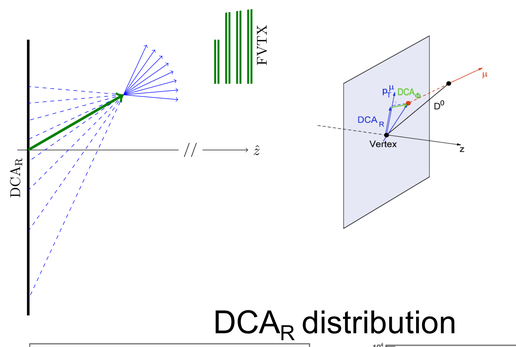
p ➔ -2.2<η<-1.2 ➔ A 1.2<η<2.4

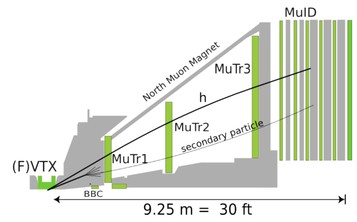
Future study – c/b separation with FVTX



- The Forward Silicon Vertex Detector (FVTX) covers 1.2<|η|< 2.4 2π in φ, 18.5cm < |z| < 38cm
- 4 disks(3 large, 1 small) per arm(N,S), 48 Modules per disk
- 3.75°per half module/column, 75 μm radial pitch

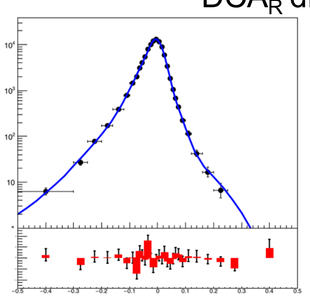
Definition of DCA_R
: Distance of Closest Approach projected onto p_T direction at collision vertex



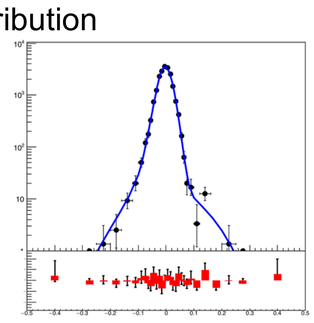


FVTX-MuTr matching and Distance of Closest Approach (DCA_R) requirements remove background of secondary particles from the back of the absorber

DCA_R distribution



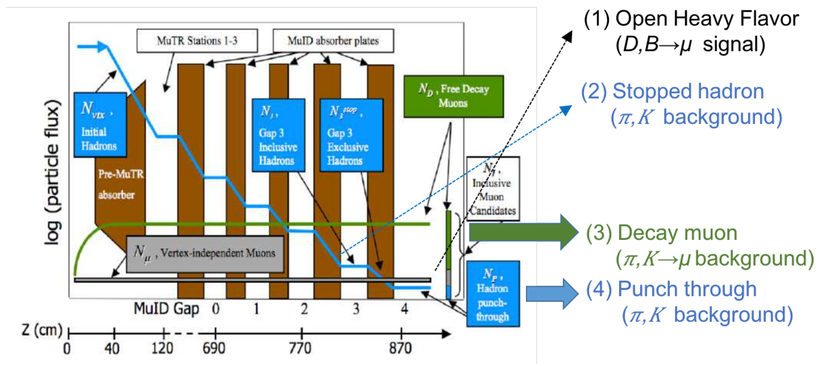
B→*μ*
2<p_T<3GeV/c



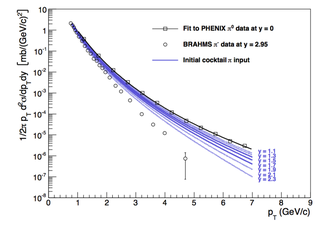
D→*μ*
2<p_T<3GeV/c

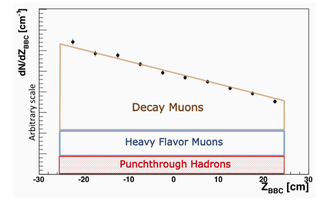
Difference of DCA_R shape for different parent particles allows us to separate charm/bottom

Analysis Overview – background subtraction



- Hadron cocktail simulation to estimate background – estimate p_T, η distribution of light-hadron background based on previous data and PYTHIA
- Decay muon (π,K→μ) background: dominant at p_T<5 GeV/c estimated by linear z-dependence caused by flight length
- Punch-through background (π,K) : hadrons penetrating all MuID gaps
- Hadron stopped at MuID Gap2,3 (π,K) : hadrons stopped in the middle of MuID by absorber. useful to estimate the amount of Punch-through hadrons.
- Estimate background by matching data and full GEANT 4 simulation





z-dependence of decay muon in North Arm (z>0)